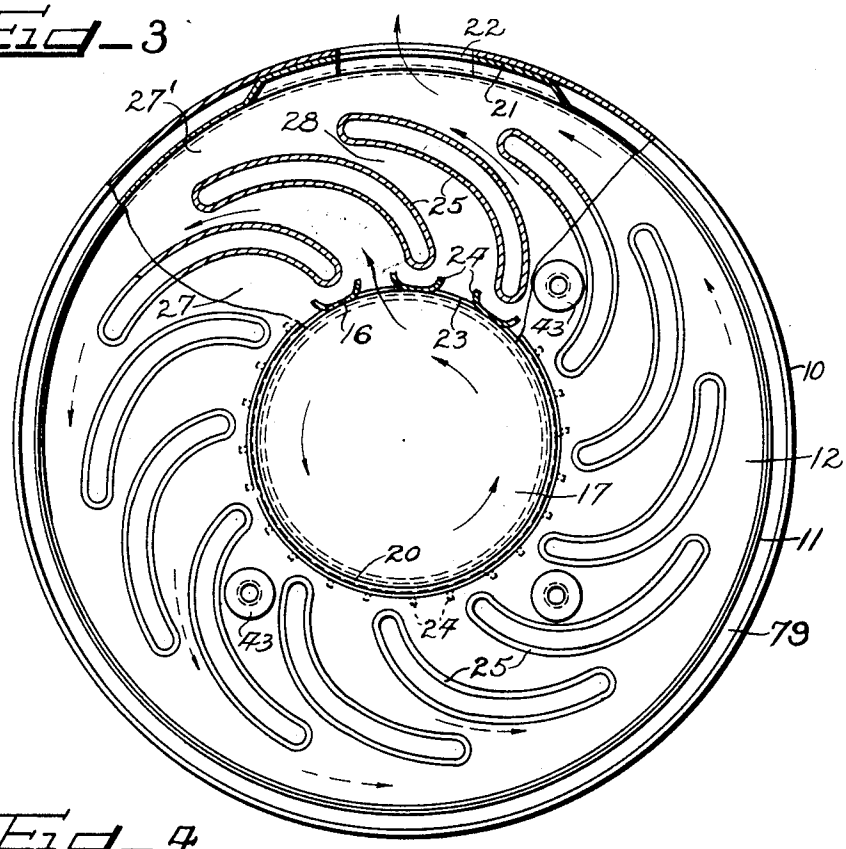
June 3, 1947. S. J. BUDLANE 2,421,370

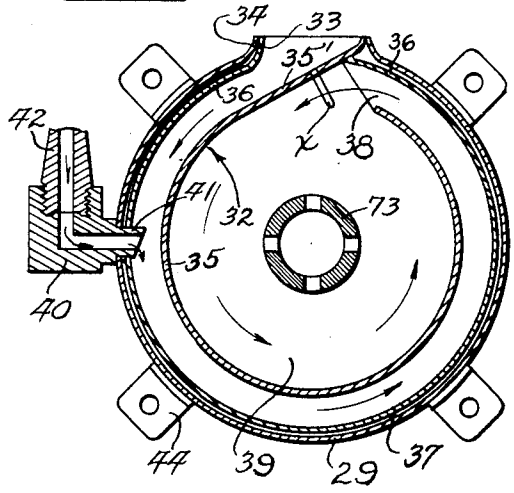
COMBUSTION CHAMBER STRUCTURE FOR HEAT EXCHANGERS

Filed April 29, 1944 2 Sheets-Sheet 1

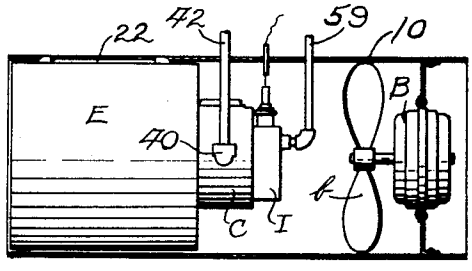
Fig—3



Fig—4



Fig—1



INVENTOR
Stanley J. Budlane

by Charles W. Hills Attys

June 3, 1947. S. J. BUDLANE 2,421,370

COMBUSTION CHAMBER STRUCTURE FOR HEAT EXCHANGERS

Filed April 29, 1944 2 Sheets-Sheet 2

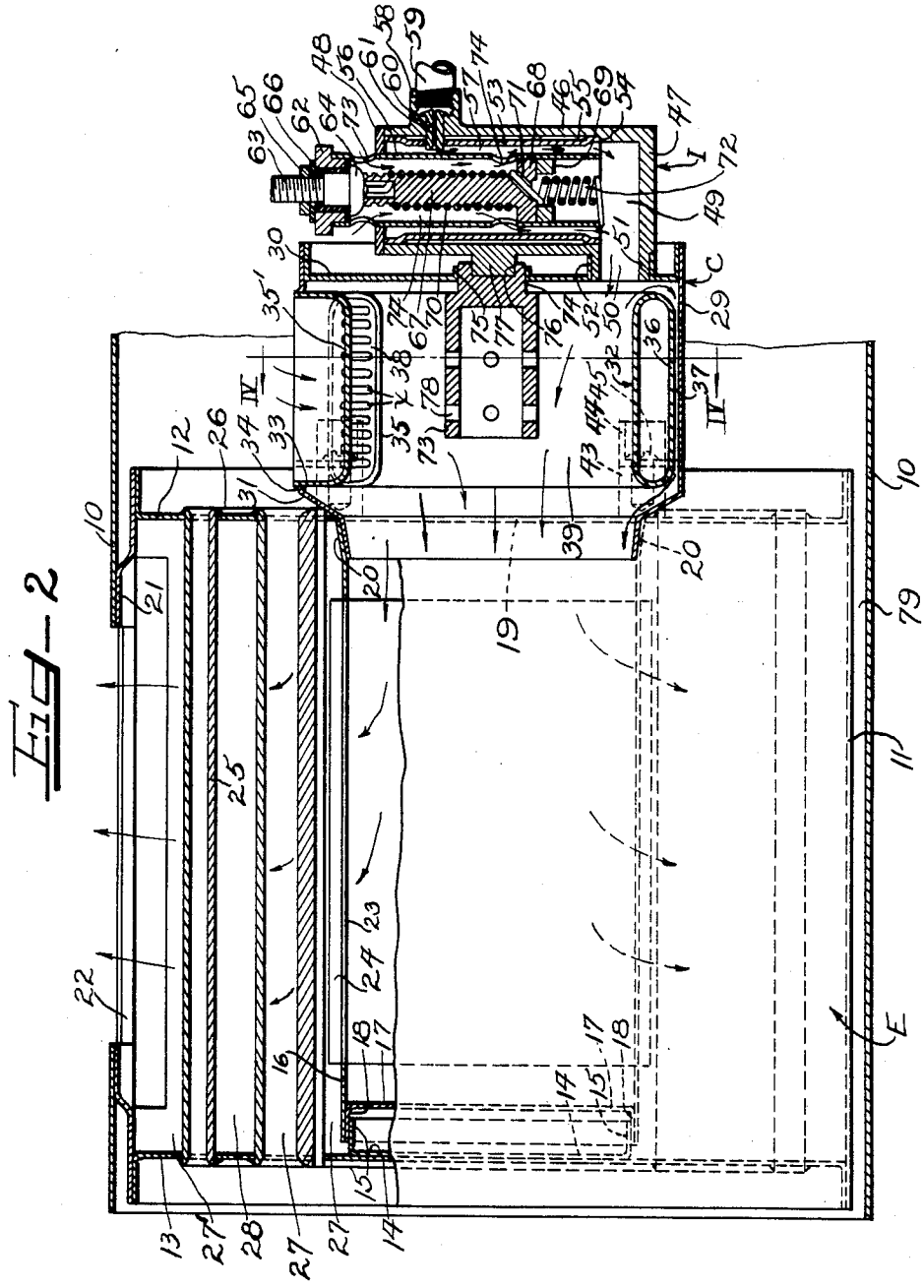


Fig-2

INVENTOR
Stanley J. Budlane
By Charles W. Hills Attys

Patented June 3, 1947

2,421,370

UNITED STATES PATENT OFFICE

2,421,370

COMBUSTION CHAMBER STRUCTURE FOR HEAT EXCHANGERS

Stanley J. Budlane, Moline, Ill., assignor to The Herman Nelson Corporation, Moline, Ill., a corporation of Illinois

Application April 29, 1944, Serial No. 533,294

2 Claims. (Cl. 126—110)

1

This invention relates to combustion chamber structures for heat exchangers adapted for general use but more particularly for heating the interior of vehicles, such as automobiles or buses.

The combustion chamber structure of my invention is used in association with a heat exchanger and comprises a cylindrical shell having an inlet opening, a circular air inlet tube extending therefrom within the shell and paralleling the cylindrical wall thereof for flow of air into the combustion chamber proper and a liquid fuel inlet adjacent to the tube inlet whereby fuel will be entrained by the air flow through the tube to be mixed therewith for delivery from the tube into said combustion chamber proper to form a combustible mixture therein. An igniter device forming a part of the structure serves to generate a pilot flame for projection into the combustion chamber for ignition of the combustion mixture therein.

A core of ceramic material in said combustion chamber cooperates with the inlet tube for rotary flow of the products of combustion and also functions to store heat for igniting the combustion mixture when air igniter is not operating. The products of combustion are discharged from the combustion chamber directly into the heat exchanger adjacent thereto.

It is therefore an object of this invention to provide a compact and efficient combustion chamber structure including an igniter device connected therewith.

A further object of the invention is the provision of heat storage means within the combustion chamber structure for continuing ignition after the electrical igniter structure is disconnected from circuit.

Other objects and features will become apparent from the following specification in connection with the drawings, in which drawings

Figure 1 is a more or less diagrammatic illustration of the heater structure and the location of the various operating elements therein;

Figure 2 is a side elevation of the heat exchanger, partly in section, and the combustion chamber and igniter structure in diametral section;

Figure 3 is an end elevation of the heat exchanger, partly in section; and

Figure 4 is a section on plane IV—IV Figure 2.

Referring to Figure 1, a housing 10 is shown of tubular form. In the forward end of the housing is mounted the heat exchanger E, the combustion structure C being mounted on the inner end of the heat exchanger, the igniter structure

2

I being mounted on the inner end of the combustion chamber housing. In the inlet end of the housing an electric fan or blower B is mounted with its blade *b* extending across the interior of the housing.

Describing first the heat exchanger E, it comprises a cylindrical shell 11 having the inner and outer end walls 12 and 13. Secured against the inner side of the outer end wall 13 concentric therewith is a plate 14 having the cylindrical flange 15 extending inwardly therefrom. The cylindrical core shell 16 is closed at its outer end by a wall 17 having the outwardly directed peripheral flange 18 of a diameter to receive the flange 15 on the plate 14, this telescoping connection holding the inner end of the core tube in axial alinement within the outer shell 11. At its outer end the core tube 16 terminates in the inlet opening 19 in the end wall, the end portion 20 of the core tube being flared.

A portion 21 of the shell 11 at the top thereof is deflected outwardly and secured, as by welding, to the housing 10, part of the portion 21 and the housing 10 being cut out to provide the longitudinally extended exhaust outlet 22 for the products of combustion. The metal of the core shell 16 is deflected outwardly to provide a circumferential row of longitudinally extending flow passageways 23, the outwardly deflected metal forming the guide wings 24 at opposite sides of the openings, as clearly shown on Figure 3. The combustion products received in the core shell flow out through the passageways 23 into and through the annular chamber 27 between the shell 11 and core shell for escape through the exhaust outlet 22.

Extending longitudinally through the annular chamber between the end walls 12 and 13 are the air ducts 25, the ends of the ducts projecting through openings in the end walls and being secured to the end walls as by welding 26. The air ducts are comparatively narrow but of extended transverse width and of spiral or involute cross-section. The ducts may readily be formed by transversely bending comparatively narrow flat tubing into the spiral or involute shape shown. The ducts are equally spaced apart in a circular row between the outer shell 11 and the core shell 16, the inner edges of the ducts being adjacent to the solid portions of the core shell between the passages 23, while the ducts terminate at their outer edges a distance inwardly from the shell 11 to leave the annular passage 27' around the ducts. With the arrangement shown, the products of combustion, received under pressure from the

combustion structure C at the inner end of the core shell 16, will be caused to flow radially outwardly from the core shell through the passages 23 into the chamber 27 for distribution through the spirally extending and outwardly converging passageways 28 between the ducts for flow into and around the space 27' to the exhaust outlet 22, the wings 24 at the sides of the openings 23 serving to direct the flow into the passages 28.

The combustion structure C comprises the cylindrical shell 29 having the inner end wall 30 and the outer end wall 31, this outer end wall being funnel shaped to fit into the flared end 20 of the core shell 16 of the exchanger E. Within the shell 29 is the air inlet structure 32 in the form of a tubular ring whose outer diameter is somewhat less than the inner diameter of the shell 29 to leave the annular space 37. This air inlet tube is of oblong rectangular cross-section, its inlet end 33 projecting into the opening 34 in the top of the shell 29 to be welded thereto. As shown on Figure 4, the air inlet tube extends from its inlet end in counter-clockwise direction in the shell 29, the inlet end 35' of inner wall 35 of the tube extending tangentially from the mouth of the inlet. The outer wall 36 of the tube parallels the shell 29 from the inlet 33 and around and up to the end 35' of the inner wall, while the inner wall terminates short of the end 35' to leave the outlet 38 for flow from the tube tangentially into the combustion space or chamber 39 surrounded by the ring. Air under pressure from the blower B will thus flow through the inlet tube 32 for discharge into the combustion chamber 39 in circular or spiral direction.

Combustion fuel, such as gasoline, is delivered into the tube 32. As shown on Figure 4 an inlet fitting 40 has its outlet end 41 projected through the shell 29 and the outer wall of the tube in radial direction. The inlet end of the fitting is connected with a fuel supply pipe 42, which as shown on Figure 1, extends to the exterior of the heater structure housing 10 for connection with a gasoline tank under control of suitable valving means (not shown). The gasoline will flow downwardly into the air tube along the outer wall 36 thereof to be vaporized and entrained by the inflowing air for flow therewith out of the tube into the combustion chamber 39 where the air and the fuel are whirled around for ignition and combustion thereof.

Secured to and extending from the inner wall 12 of the heat exchanger shell 11 are a number of studs 43 on which seat brackets 44 on the combustion chamber shell 29, screws 45 securing the brackets to the studs for supporting the combustion chamber structure C on the heat exchanger with its funnel end 31 in engagement in the flared end 20 of the core shell 16, as shown on Figure 2. The products of combustion will thus flow from the combustion chamber into the exchanger core for outflow through the passageways 28 between the air ducts 25.

Describing now the igniter structure, it comprises the cylindrical housing 46 having the bottom wall 47 and the top wall 48. In the lower end of the housing is the ignition chamber 49 from which extends the passageway 50 through the annular flange 51 on the housing. The end wall 30 of the combustion structure is deflected outwardly to provide a ferrule 52 in which the flange 51 seats for connection of the ignition chamber 49 with the combustion chamber 39. Within the body 46 is a thin metal sleeve 53 which seats at its lower end on the annular shoulder 54 in the housing 46 above the chamber 49 and at its upper end is abutted by the top wall 48 of the housing. Intermediate its ends this tube 53 is contracted radially inwardly to leave the clearance space 55 therebetween and the wall of the housing 46, this space serving as an insulator jacket to retain heat within the structure.

A metal air inlet tube 56 extends downwardly through the top wall 48 of the housing and through the sleeve 53 and terminates at the ignition chamber 49. This air tube is of less diameter than the sleeve 53 to leave the annular space 57 through which gasoline flows downwardly toward the ignition chamber 49. The gasoline inlet boss 58 is provided on the housing 46 near the upper end thereof for connection by a pipe 59 with a source of gasoline. As shown on Figure 2, this pipe 59 extends upwardly out of the heater structure housing 10 for connection with a gasoline source under control of suitable valve means (not shown). A metering plug 60 extends through the bottom of the inlet boss and the sleeve 53 to the space 57 and has the flow orifice or metering passageway 61 therethrough for controlling the flow of the gasoline into the space 57.

The upper end of the air tube 56 is closed by a plug 62 through which extends a terminal member 63 terminating at its inner end in a head 64. This terminal member is secured as by a nut 65 and the terminal member and the nut are insulated from the plug 62 by suitable insulating material 66. Extended upwardly into the air tube 56 and terminating adjacent to the terminal head 64 is the spindle 67 of ceramic material which has the head 68 at its lower end snugly fitting into the air tube a distance above its lower end to hold the spindle in place, and a ceramic washer 69 may also be provided in the air tube to abut the spindle head. The spindle supports a resistance wire helix 70 whose upper terminal is secured in electrical contact with the head 64 of the terminal member 63. The lower terminal of the coil extends down through a passageway 71 in the spindle head 68 for connection with the upper terminal of an ignition coil 72 located in the lower end of the air tube for exposure to the ignition chamber 49, the lower terminal of this coil being secured in electrical contact with the end of the air tube 56 to be grounded thereto. As shown on Figure 1, a current supply conductor extends from the terminal member 63 for connection with one terminal of a source of current supply, as for example a battery (not shown), whose other terminal is grounded. The connection of the terminal 63 with the current source is properly controlled by suitable switch means (not shown). When the terminal is connected with the current source, current will flow through the coils 70 and 72 and back through the ground connection to the battery, the metallic frame work of the heater structure constituting the ground circuit.

The air tube 56 above the top wall 48 of the housing 46 has air inlet openings 73 into the space between the spindle coil and the air tube through which space air under pressure from the blower will flow downwardly into the space 57 through openings 74 in the air tube just above the head 68 of the spindle. This down-flowing air will meet the gasoline flowing downwardly in the space 57 from the inlet orifice 61 and the combined air and gasoline will flow into the ignition chamber 49. During travel of the air through the space 74 it is preliminarily heated

by the coil 70, and the air tube and the sleeve 53 are also heated so that the gasoline entering the space 57 will be heated and vaporized to mix with the out-flowing air at the air outlets 74. The coil 72 is of comparatively close pitch and the current flow therethrough will cause it to become highly heated, and this heat is radiated to the lower end of the air tube for further heating of the mixed air and vapor while flowing through the lower end of the space 57. The mixed air and vapor then enter the ignition chamber 49 and will spread out in the ignition chamber 49 and into the lower end of the air tube in close contact with the coil 72 for ignition of the mixture to produce a pilot flame which is projected into the combustion chamber 39 for ignition of the combustion mixture delivered to the combustion chamber through the inlet tube 32. The heat from the spindle coil 70 will be sufficient to preheat the air and gasoline without causing ignition thereof, but the coil 72 will be heated to a glow temperature which will quickly ignite the mixture.

A tubular ignition member 73 of ceramic material extends axially into the combustion chamber 39 and is supported by the engagement of its base 74 through an opening 75 in the end wall 30. On its outer side, the base has the recess 76 which receives the boss 77 extending from the housing 46 of the igniter structure.

When the heater structure is to be started for operation, the gasoline flow to the fitting 40 and the gasoline flow to the igniter are shut off, and the igniter circuit is then closed and after a short period the coils in the igniter will be heated, and then the valve is opened for gasoline flow to the igniter fos generation of the combustion mixture and ignition thereof in the ignition chamber 49 for formation of the pilot flame which will spread into the main combustion chamber 39. The valve is now opened for flow of gasoline into the air tube 32 through the fitting 40, and the air and gasoline entrained thereby will flow into the combustion chamber 29 to be ignited by the pilot flame. The combustion structure will become quickly heated, a portion of the products of combustion flowing transversely around the tube 32 through the space 37 between the tube and the shell 29. This flow through the space 37 will heat the outer wall 36 of the combustion chamber so that the gasoline flowing from the inlet 40 will drop onto and flow downwardly along the wall 36 to become quickly vaporized. The combustion heat within the combustion chamber 39 and the heat from the products of combustion flowing through the space 37 will also preheat the air flowing into the tube, the preheated air and the vaporized gasoline then thoroughly mixing on their progression through the tube 32 to be delivered from the tube outlet 38 against the tangential wall 35' for ignition and rotary or spiral movement of the products of combustion in the combustion chamber and flow therefrom into the exchanger E. The degree of heating of the outer tube wall by the flow through the annular passageway 37 depends upon the radial depth of this passageway, the greater the depth the greater amount of heat applied to the outer wall 36. With this heating of the inner and outer walls of the tube the inflowing gasoline will be rapidly vaporized and received by the inflowing preheated air to form the combustion mixture issuing from the tube outlet 38. If this combustion mixture were allowed to burn at the outlet 38 the flame would tend to oscillate into and out of the tube at the outlet and generate acoustic energy which would result in disagreeable noise. I therefore preferably provide a grid structure adjacent to the outlet 38, and this grid structure, as shown, may comprise a row of pins X extending inwardly from the tangential end 35' of the inner tube wall in the path of the combustion mixture flowing from the outlet 38. These pins will intercept the mixture and cause it to spread out for flow between the pins for ignition at the inner sides of the pins, and oscillation of flame at the outlet will be prevented and the combustion structure will operate smoothly and quietly.

The ceramic member 73 forms a core in the combustion chamber 39 around which the combustion flame rotates and is stabilized. The ceramic member may be provided with holes 78 through which the flame may flow for more readily maintaining the member at igniting temperature so that this member may take care of the ignition in the combustion chamber after the igniter mechanism I has been disconnected.

As shown in Figure 4, the direction of rotation of the flame and products of combustion is in a counter-clockwise direction, and as the products of combustion flow into the core shell 16 of the exchanger they retain more or less of this rotary motion and flow outwardly through the passageways 23 and along the passageways 28 between the air ducts 25. As these passageways 28 converge outwardly, the velocity of the flow therethrough is increased as the temperature of the flow decreases so that the heat from the products of combustion traveling between the transversely extended sidewalls of the air ducts may be efficiently and uniformly absorbed by the air flowing through the ducts. As the passageways 28 between the air ducts extend in spiral direction, the products of combustion flowing therefrom will then travel around in counter-clockwise direction, Figure 3, through the space 27' for discharge through the exhaust outlet 22. The air blown through the heater structure housing 10 by the blower will flow through the air ducts 25 for delivery into the space to be heated, and air will also flow out through and be heated in the narrow annular passage 79 between the exchanger outer shell 11 and the housing 10.

I have thus produced a simple, compact and efficient heater structure which may be of various sizes depending upon the output desired and which is readily portable and readily installed for service.

I have shown and described a practical and efficient embodiment of the various features of my invention, but I do not desire to be limited to the exact construction, arrangement or operation shown and described as changes and modifications may be made without departing from the scope of the invention.

I claim as my invention:

1. In a heater assembly comprising a housing defining a passageway for air flow under pressure to a heat exchanger therein having an inlet for products of combustion, a combustion structure comprising a cylindrical shell connected at one end with the heat exchanger inlet, said shell having an opening at its top, a circular air inlet tube within said shell paralleling the cylindrical wall thereof, said tube having an inlet terminating in said shell opening and having an outlet exposed to the space surrounded by said tube which space constitutes a combustion chamber,

the inlet of said tube being exposed to said airflow passageway for flow of air under pressure through said tube into said combustion chamber, means including a liquid fuel inlet to said tube adjacent to the tube inlet whereby fuel will be entrained by the air flow through the tube to be mixed therewith for delivery from said tube into the combustion chamber to form a combustion mixture in said chamber, and an igniter structure connected with said combustion structure for generating a pilot flame for projection into said combustion chamber for ignition of the combustion mixture therein.

2. In a heater assembly comprising a housing defining a passageway for air flow under pressure to a heat exchanger therein having an inlet for products of combustion, a combustion structure comprising a cylindrical shell connected at one end with the heat exchanger inlet, said shell having an opening at its top, a circular air inlet tube within said shell paralleling the cylindrical wall thereof, said tube having an inlet terminating in said shell opening and having an outlet exposed to the space surrounded by said tube which space constitutes a combustion chamber, the inlet of said tube being exposed to said airflow passageway for flow of air under pressure through said tube into said combustion chamber, means including a liquid fuel inlet to said tube adjacent to the tube inlet whereby fuel will be entrained by the air flow through the tube to be mixed therewith for delivery from said tube into the combustion chamber to form a combustion mixture in said chamber, an igniter structure connected with said combustion structure for generating a pilot flame for projection into said combustion chamber for ignition of the combustion mixture therein and flow of the products of combustion into said heat exchanger, and a core of ceramic material in said combustion chamber cooperating with said inlet tube for rotary flow of the products of combustion and functioning also to store heat for igniting the combustion mixture when said igniter is not operating.

STANLEY J. BUDLANE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,022,116	Kruse	Nov. 26, 1935
1,656,486	Huntington et al.	Jan. 17, 1928
1,017,180	Sherman et al.	Feb. 13, 1912
2,366,416	McCollum	Jan. 2, 1945
2,379,018	McCollum	June 26, 1945
2,215,983	Smith	Sept. 24, 1940
1,582,913	Ewing	May 4, 1926
2,379,017	McCollum	June 26, 1945

FOREIGN PATENTS

Number	Country	Date
444,632	Great Britain	Mar. 17, 1936